Space Weather Technical Forecast

Issued on Sunday, 14 April 2024 at 13:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance G1/G2 on 14 or 15 Apr from CME arrivals, and coronal hole high speed stream onset. Chance of isolated M-flares.

Solar Activity: Moderate with one M-class flare, peaking M4.3 at 14/0232 UTC from AR3637 in the southeast. There are eleven sunspot regions on the disc, with the majority of these small and simple. The largest region is AR3634 which has seen ongoing emergence of intermediate spots along with lengthening of the region, but remains a simple bipolar configuration. This also produced a C5.5 flare at 13/1459 UTC. AR3636 has produced a recent C4.9 flare and potential CME, although initial analysis does not suggest that this would be Earth directed. A number of small sunspots are visible within plage on both the southeast and northeast limbs.
A CME was produced from the C5.5 flare, however this appears to be slow and relatively narrow, largely passing north and behind Earth, although there is the potential for a glancing impact. No other Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar winds as observed at L1, persisted at background, between 300-400 km/s. Density remained below average even with a slight upward trend. Interplanetary magnetic field (IMF) strength, Bt, was weak below 6nT, with the north-south component, Bz, varying weakly. Phi angle started positive (away from the Sun), but switched polarity to a negative orientation at around 14/0630 UTC. Resultant geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at Background. High energy electron flux (greater than 2MeV) observed at GOES16 was background to moderate, with a peak of 460pfu observed at 13/1825UTC. The associated 24-hour fluence remained below Active (1e8 integrated flux) with a value of 1.58e7 integrated pfu recorded at 14/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Low to Moderate solar activity is expected, with a chance of further isolated M-class flares.

Solar Wind / Geomagnetic Activity: Three CMEs may affect the Earth through the forecast period. A first which erupted on 11 Apr may glance the Earth on 14 Apr. The second which left centre disc on 12 Apr is forecast for an arrival early on 15 Apr, while a third from the vicinity of AR3634 on 13 Apr has a low confidence of a glancing blow on 15 or 16 Apr. Solar wind speeds are forecast to increase to around 450-500km/s on 14 Apr due to the high speed stream from coronal hole 24, then decline on 16 Apr. Geomagnetic activity is expected to increase from Quiet or Unsettled to Active with a chance of G1/Minor to G2/Moderate Storm intervals on 14 or 15 Apr due to the combined high speed stream or CME arrivals. A decline in activity is then expected as the effects of these events wane.

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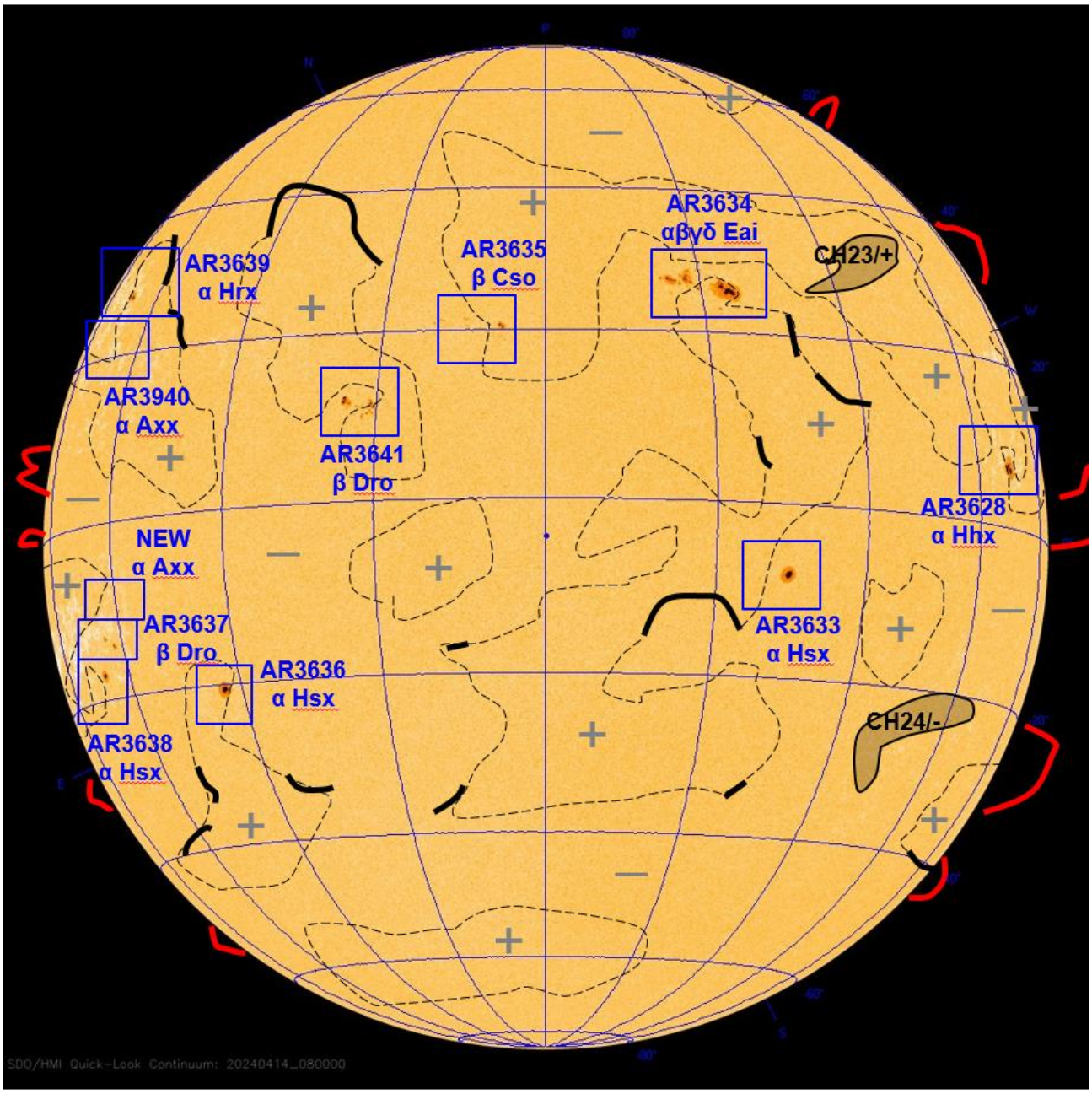
Energetic Particles / Solar Radiation: High energy proton flux as observed by GOES18 is expected to persist at Background. High energy electron flux at GOES16 is expected ease to background with the onset of any fast wind and CME arrivals, before likely rising through 16 and 17 Apr. This will give a slight chance of the associated 24 hour fluence reaching the Active threshold by the end of the period.

Figure 1. Solar Analysis Valid 14/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Three CMEs are forecast to arrive at the Earth during the forecast period. The first left the north-centre of the Sun on 11 Apr and is due to arrive as a glancing blow either late on 14 Apr or early on 15 Apr. The second CME, which left centre disc early on 12 Apr, is due to arrive early on 15 Apr. A third CME, as a result of a C5.5 flare from AR3634 may glance the Earth 17 Apr but with low confidence. Enlil background winds are significantly higher than those observed, so arrival times may be slower than those forecast by the model.

A high speed stream from coronal hole 24 is due to connect with Earth on 14 Apr, with speeds around 450km/s observed on the last rotation of this recurrent feature. Similar speeds are forecast on this occasion with a decline in speeds then forecast from 16 Apr onward.

Geomagnetic activity is forecast to start quiet to Unsettled, then becoming Active with a chance of G1/Minor or G2/Moderate Storm intervals on 14 and 15 Apr due to potential combined CME and high speed stream effects. Activity is then expected to decline as these effects ease.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	50	5	1
Strong	G3	No	5	10	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
12/0620	Full	Filament	Southwest	670km/s	15/0300 - 4/+8hrs	Direct hit, but low confidence in strength
11/0540	Partial	Filament	North-centre	856km/s	14/2100 - 4/+8hrs	Glancing blow
13/0129	Partial	C5.5 flare	AR3634	444km/s	17/1800	Low confidence

Figure 2: Enlil ensemble showing the spread in potential CME arrival times.

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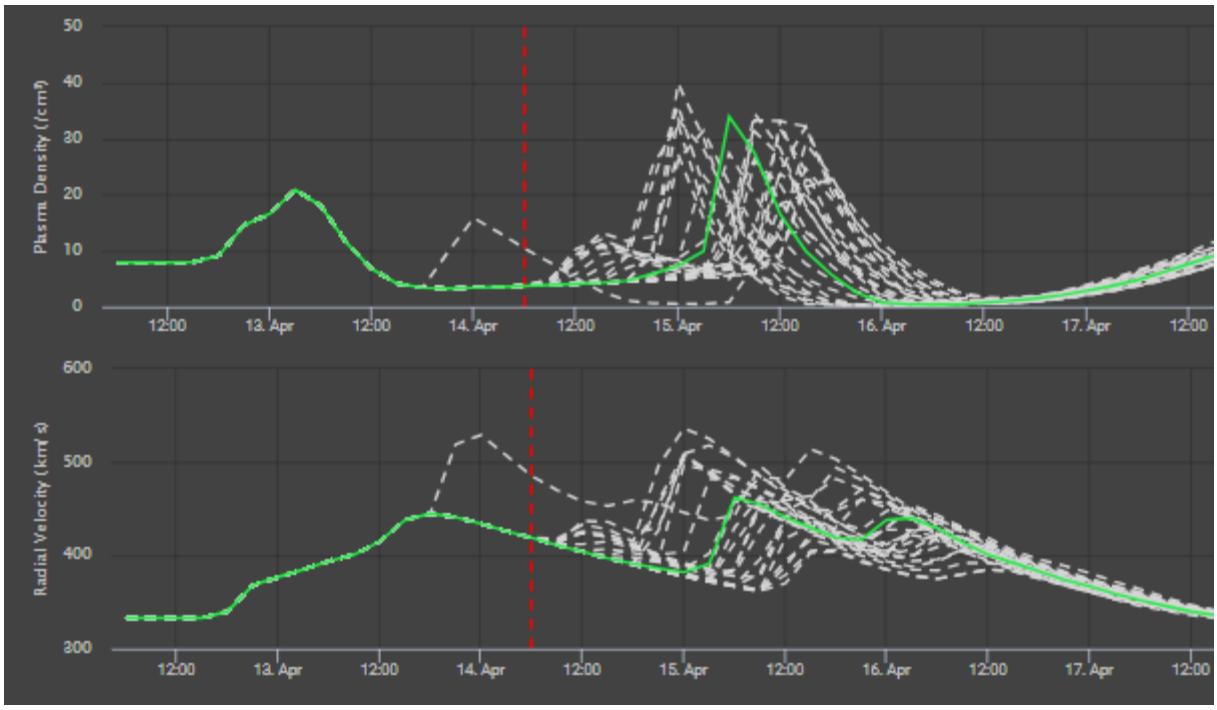

Radio Blackouts - X-Ray Flares:
Low to Moderate activity is forecast through the period, with a likelihood of isolated M-class flare activity.

AR3634 is the most significant feature on the solar disc, and has grown in size and length, but has produced limited activity with a simple magnetic structure. AR3637, in the southeast, has been the most active region, with the sole M-class flare from the previous 24 hours. This may be related to the forecast returning region of ex-AR3615 with the full magnitude of any region likely to become apparent through the next 24 hours. The developments in the northeast may also correspond to a returning region, ex-AR3614, and this will be monitored over the coming days. Both the northeastern and southeastern areas exhibit large areas of flux close to the limb, with this extending beyond the limb, lending confidence to a potential appearance of complex sunspot regions.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

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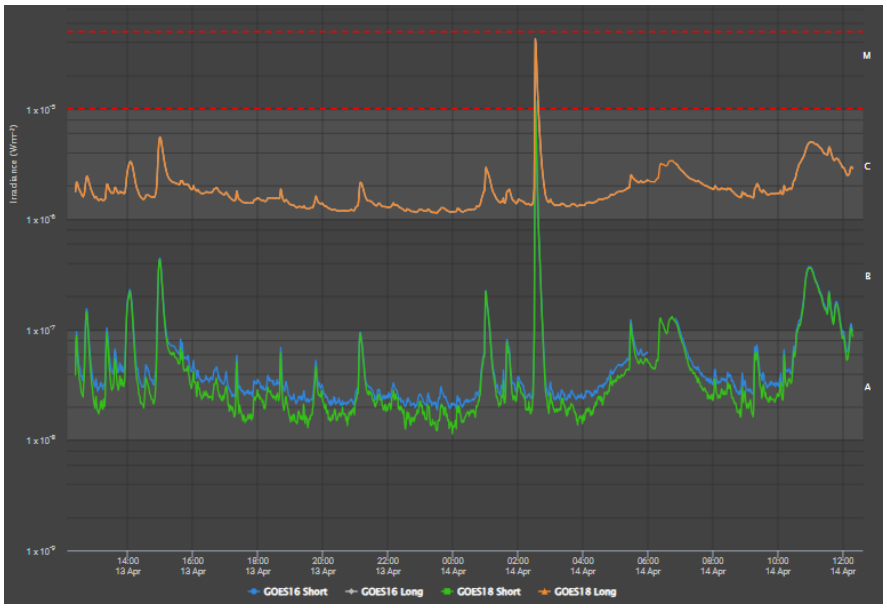
Figure 3: GOES 16 X-ray flux



Solar Radiation Storms - (High Energy Protons):

High energy proton flux as observed by GOES18 has remained at Background levels. Solar radiation storms are currently not expected, though a very slight chance of flux increasing is maintained throughout mainly due to the slight development of AR3634 as it moves into the western disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux is forecast to continue to oscillate at background to moderate values in the absence of significant inputs into the radiation belts. CME and high speed stream arrivals are initially expected to inhibit accumulations, due to distortion of the belt and geomagnetic enhancements. As these effects wane, moderate or high values are likely to become increasingly likely on diurnal peaks.

Associated electron fluence is forecast to start below the Active (1e8 integrated pfu) threshold, but with an increasing trend most likely through 16 and 17 Apr.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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